

You're in the Driver's Seat

Project Overview

The premium that an auto insurance company charges for a policy is dependent on many factors including driving record, number of years of driving experience, age, whether the driver is the principal operator of the vehicle, and whether the driver has had driver training. These factors are encoded in the Safe Driver Insurance Plan (SDIP) step and the rate class assigned to a driver on a policy. The task in this project is to investigate real data from an insurance company to discover the relationships between the driver demographics and the premiums.

The Problem

You are provided with some sample data obtained from First Stage Insurance Agency. Your job is to analyze the data to answer the following questions.

1. Do drivers with higher SDIP steps have a higher incident of claims?

Does the percent of policies that have claims against them increase as the SDIP step increases? Plot these variables against each other and determine the best-fit line.

Extension 1: Does the equation of the line change when the scatter plot is made for an individual rate class? If so, how?

2. How does policy premium vary with SDIP step?

Given the average policy premium for each SDIP, can you find the best-fit line? How does your line compare to the rule used by the insurance companies for SDIP credits and penalties?

3. Which SDIP steps yield the largest profit for the insurance company?

Why do you think this is so?

4. What is the total cost of a speeding ticket?

While the cost of the ticket may hurt in the short term, the major cost to the driver is the increase in the insurance premiums. Investigate how much the ticket really costs considering the increased premiums.

5. How do premiums change with the new rules of the point system?

Analyze four Maine drivers and how their premiums have changed with the new point system.

Background Information:

The SDIP Step System

The Safe Driver Insurance Plan (SDIP) assigns a step number to each driver based on their driving record. The steps range from 9 to 35. Drivers are initially assigned an SDIP of 15. This SDIP is reduced by 1 for every year of incident-free driving. If a driver has three consecutive years of incident free driving and their step is over 14, it is reduced to 14 at the end of the three year period. Once a driver is involved in an accident in which they are at fault, or receives a ticket for a violation, the SDIP is increased 2 to 5 steps according to the severity of the accident or violation. This is summarized in the table below.

Surchargeable Incident	Increase in SDIP Level
Major Traffic Violation (i.e., D.U.I.)	5
Major At-Fault Accident (claim over \$2,000)	4
Minor At-Fault Accident (claim over \$500 to \$2,000)	3
Minor Traffic Violation (i.e., speeding)	2

The insurance premium charged by the insurance company depends on the driver's SDIP level. The premiums are defined based on step 15. For every step less than 15 the premium is reduced by 7%; for every step above 15, it is increased by 7%. However, for experienced operators the premium increases by 10% for each step over 19.

Rate Class Definitions

Each driver is assigned a rate class according to the following table. The information in which the insurance company is interested is dependent on the number of years of experience of the driver. For drivers with at least 6 years of experience there are only two classes dependent on the driver's age. For drivers with less than 6 years of experience, the insurance company is interested to know whether the driver is the principal user of the automobile, or whether they are the occasional user of someone else's car, typically their parents. A discount is given for drivers that have had driver training, but this discount only applies to drivers with less than three years experience.

Years of Driving Experience		
Less than 3 years	At least 3 but less than 6	At least 6 years
20 – Principal Operator No driver training	17 – Principal Operator	10 – Under 65 years old
21 – Occasional operator No driver training	18 – Occasional Operator	15 – At least 65 years old
25 – Principal Operator with driver training		
26 – Occasional Operator with driver training		

Question 1: Do drivers with higher SDIP steps have a higher incident of claims?

Exercises:

1. Complete the table of values on the next page to compute the percent of policies with claims for each SDIP step.
2. Prepare a scatterplot of the **percent of policies with claims vs. their SDIP levels**.
3. Do you think a linear model is appropriate for this data set?
4. Find a line of best fit. Interpret the equation of the line in the context of the problem. If SDIP step increases by 1, what change in the percent of policies with claims does the line predict?

Question 1 – Line of Best Fit Table

SDIP Level	Number of Policies	Number of Policies with Claims	Percent with Claims	Number of Policies without Claims	Percent without Claims
9	152039	13305			
10	37857	3938			
11	7053	813			
12	3698	415			
13	20521	2364			
14	14485	1766			
15	14314	1802			
16	3185	452			
17	2998	406			
18	2664	388			
19	1885	300			
20	1231	205			
21	965	161			
22	762	133			
23	622	104			
24	460	65			
25	344	69			
26	250	41			
27	203	31			
28	151	29			
29	127	31			
30	78	19			
31	72	15			
32	50	11			
33	41	8			
34	33	2			
35	100	18			

Graph Paper



SDIP Level

Percent of policies with losses

Question 2: How does the policy premium vary with SDIP?

The following table gives the average premium charged by SDIP and rate class. Graph the average premium vs. SDIP and find the relationship between SDIP step and average premium. (A blank cell indicates that no policy holders had that particular combination of SDIP and rate class).

Fit a regression line to the data, using the “Average” column to include all rate classes. How strong is the linear relationship between Premium and SDIP?

SDIP	RC 10	RC 15	RC 17	RC 18	RC 20	RC 21	RC 25	RC 26	Average
09	\$697.46	\$536.26	\$720.24	\$703.74	\$832.92	\$808.87	\$447.29	\$818.79	\$662.91
10	\$800.95	\$641.30	\$951.78	\$852.18	\$1,107.70	\$931.84	\$924.36	\$871.93	\$790.48
11	\$884.67	\$756.82	\$1,114.27	\$972.68	\$1,182.63	\$962.22	\$1,002.24	\$925.02	\$915.53
12	\$955.91	\$744.27	\$1,210.63	\$1,009.66	\$1,466.02	\$1,088.03	\$1,221.16	\$1,056.20	\$1,025.86
13	\$1,038.69	\$799.64	\$1,290.06	\$1,127.95	\$1,634.86	\$1,201.07	\$1,517.16	\$1,267.89	\$1,025.29
14	\$1,109.80	\$859.86	\$1,382.55	\$1,182.09	\$1,724.77	\$1,413.85	\$1,613.43	\$1,333.36	\$1,131.26
15	\$999.77	\$751.32	\$1,352.28	\$1,185.80	\$1,734.50	\$1,380.58	\$1,685.06	\$1,344.48	\$1,127.52
16	\$1,233.47	\$1,002.77	\$1,525.13	\$1,324.51	\$1,762.28	\$1,687.44	\$1,814.72	\$1,483.96	\$1,279.08
17	\$1,281.31	\$1,012.84	\$1,618.81	\$1,342.25	\$1,923.08	\$1,358.75	\$1,925.62	\$1,532.78	\$1,330.89
18	\$1,318.69	\$1,005.22	\$1,730.79	\$1,450.34	\$2,348.14	\$1,938.84	\$2,066.73	\$1,683.36	\$1,410.93
19	\$1,396.82	\$1,088.05	\$1,716.42	\$1,439.21	\$2,466.54	\$1,865.33	\$2,112.74	\$1,670.62	\$1,469.30
20	\$1,400.04	\$1,211.02	\$1,847.10	\$1,553.76	\$2,029.52	\$1,910.72	\$2,319.29	\$1,735.65	\$1,478.56
21	\$1,471.22	\$1,174.94	\$1,751.76	\$1,674.47	\$2,644.44	\$2,184.25	\$2,277.51	\$1,735.78	\$1,540.64
22	\$1,529.04	\$1,184.76	\$1,965.85	\$1,665.24	\$2,723.30	\$1,722.86	\$2,178.27	\$2,265.81	\$1,618.06
23	\$1,622.71	\$1,218.11	\$1,961.53	\$1,836.08		\$1,718.74	\$2,354.25	\$2,256.95	\$1,679.28
24	\$1,675.69	\$1,036.73	\$2,152.11	\$1,806.79	\$3,203.36		\$2,257.17	\$2,144.60	\$1,752.32
25	\$1,731.15	\$1,684.34	\$2,390.99	\$2,239.74		\$2,089.40	\$2,631.50	\$2,674.51	\$1,871.80
26	\$1,748.07	\$1,616.22	\$2,433.39	\$2,193.81			\$4,284.89	\$2,836.91	\$1,901.67
27	\$1,723.36	\$2,253.22	\$2,271.74	\$1,879.19				\$1,272.12	\$1,805.10
28	\$1,880.16	\$1,466.26	\$2,321.80	\$1,603.70		\$2,304.43		\$1,606.06	\$1,891.22
29	\$1,917.25	\$2,017.58	\$2,742.10	\$1,462.48			\$3,415.49		\$2,028.99
30	\$2,063.58	\$1,410.94	\$3,042.50				\$2,048.46		\$2,083.03
31	\$2,250.77		\$2,753.35	\$2,126.92			\$2,760.95		\$2,377.04
32	\$2,369.13			\$785.25		\$2,214.67			\$2,195.29
33	\$2,210.48	\$2,683.76		\$2,169.39					\$2,264.50
34	\$2,452.55							\$3,780.20	\$2,642.22
35	\$2,134.83		\$2,584.86	\$1,790.08			\$3,181.47	\$4,661.22	\$2,324.01
Grand Total	\$820.71	\$594.24	\$1,322.00	\$1,146.45	\$1,772.55	\$1,385.80	\$1,699.97	\$1,371.51	\$820.50

The insurance manual (www.aib.org) indicates that the collision insurance premiums are based on a step of 15 and then the premium is reduced by 7% for every step below 15, and increased by 7% for each step above 15. For steps above 19 a 10% increase is applied per step.

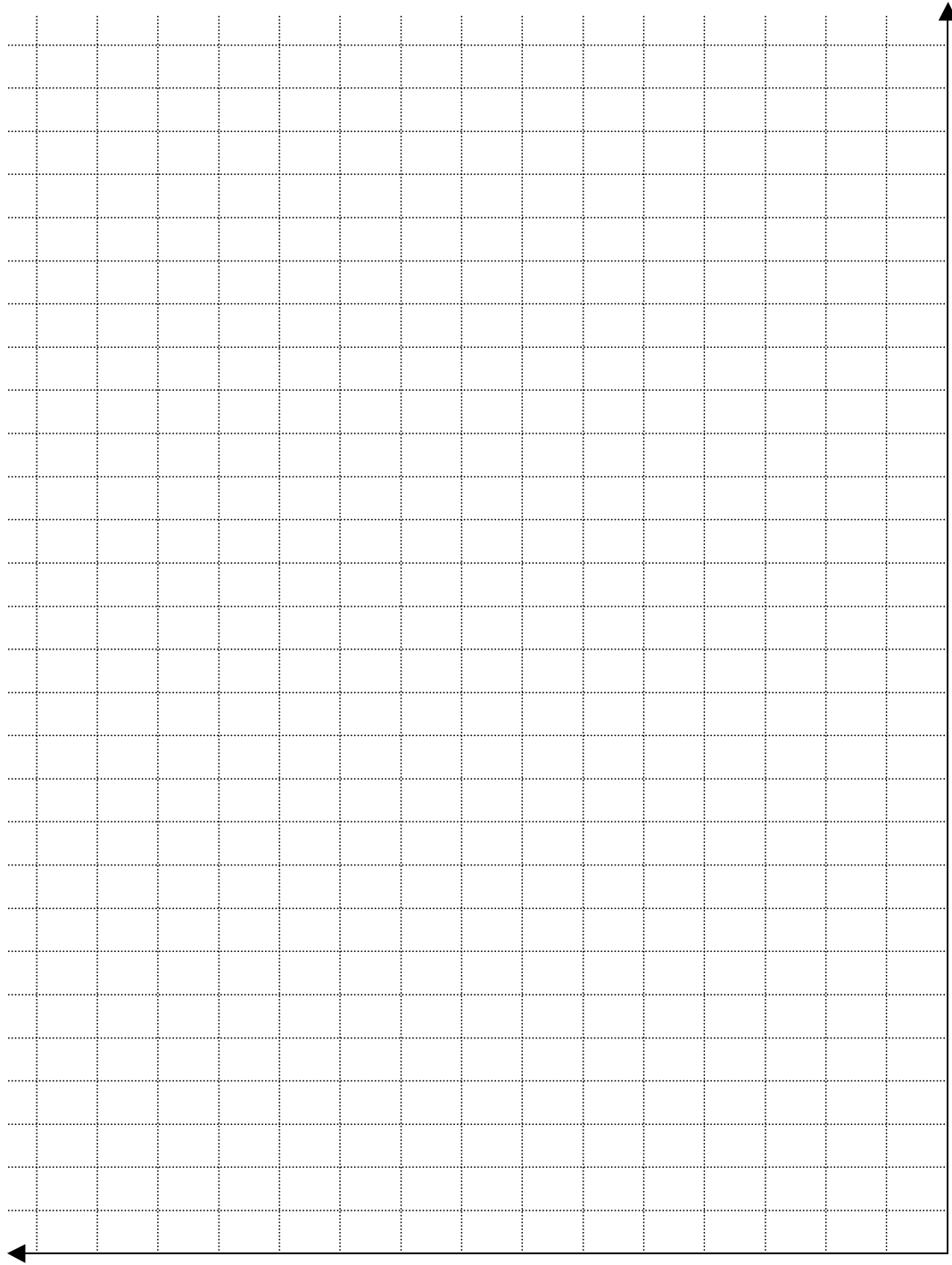
Does the data for the average premium and SDIP step support the information given in the manual? If not, what could be some reasons for the difference?

Extension: Does the policy premium vs. SDIP relationship vary with rate class?

Plot the average premium for rate class 18 against SDIP step. Find the line of best fit for the data. What differences do you observe between this graph and the graph that includes all rate classes



Rate Class 18 Premium vs. SDIP Level



SDIP Level

Premium Cost

Question 3: Which SDIP steps yield the largest profit for the insurance company?

The table on the following page includes the total losses for the insurance company, in dollars, for each SDIP.

Calculate the following information to complete the table.

- Net Profit= Total Revenue – Total Losses
- Average Profit (divide net profit by number of policies)
- Average Loss per Policy (divide loss by number of policies).
- Average Loss per Claim (divide loss by number of claims)

Discuss which SDIP steps are most profitable for the insurance company, as well as possible reasons why this is the case.

SDIP	Number of Policies	Number of Policies with Claims	Total Losses (\$)	Total Revenue (\$)	Net Profit (\$)	Average Profit (\$)	Average Loss per Policy (\$)	Average Loss per Claim (\$)
09	152039	13305	\$37,654,878.43	\$100,803,476.45				
10	37857	3938	\$10,777,694.89	\$29,915,929.29				
11	7053	813	\$2,213,576.82	\$6,452,137.66				
12	3698	415	\$1,612,912.91	\$3,789,145.36				
13	20521	2364	\$7,779,020.03	\$21,042,522.82				
14	14485	1766	\$5,241,657.04	\$16,372,229.62				
15	14314	1802	\$8,546,389.23	\$16,120,317.86				
16	3185	452	\$1,597,518.49	\$4,074,103.14				
17	2998	406	\$1,518,472.08	\$3,980,209.11				
18	2664	388	\$1,350,318.96	\$3,755,985.75				
19	1885	300	\$1,400,230.02	\$2,778,072.88				
20	1231	205	\$863,640.32	\$1,826,103.68				
21	965	161	\$532,077.43	\$1,487,431.26				
22	762	133	\$740,962.61	\$1,230,503.92				
23	622	104	\$494,380.54	\$1,045,546.65				
24	460	65	\$177,252.05	\$803,484.12				
25	344	69	\$385,187.15	\$632,160.04				
26	250	41	\$138,953.20	\$467,376.99				
27	203	31	\$130,758.06	\$376,444.35				
28	151	29	\$121,049.21	\$289,238.39				
29	127	31	\$150,813.45	\$249,984.87				
30	78	19	\$64,167.60	\$160,283.50				
31	72	15	\$60,063.70	\$163,413.08				
32	50	11	\$142,973.96	\$111,237.89				
33	41	8	\$20,209.78	\$93,343.15				
34	33	2	\$10,898.17	\$81,858.25				
35	100	18	\$216,079.76	\$234,089.22				

Question 4: What is the Actual Price of a Ticket?

Getting pulled over for going 40 mph in a 30 mph speed zone usually results in a fifty dollar ticket. Is that all that ticket really costs you? Unfortunately, if this is your second ticket (the first ticket in Maine does not affect your SDIP rating) for a minor moving violation (stop sign, speeding, etc.), the price of the ticket is just the beginning. This incident affects your insurance premium by changing your SDIP rating; the second ticket for a minor moving violation increases your SDIP rating by two steps. The increases in one's SDIP step for various types of violations are summarized in the table below.

Surchargeable Incident	Increase in SDIP Level
Major Traffic Violation (i.e., D.U.I.)	5
Major At-Fault Accident (claim over \$2,000)	4
Minor At-Fault Accident (claim over \$500 to \$2,000)	3
Minor Traffic Violation (i.e., speeding)	2

The table below gives the premium for an insurance policy at each SDIP level. Although premiums vary from person to person, assume for this problem that premium is entirely determined by SDIP level. This information will be used to answer the questions on the next page.

SDIP Level	Premium
9	\$662.91
10	\$790.48
11	\$915.53
12	\$968.23
13	\$1,025.29
14	\$1,076.41
15	\$1,127.52
16	\$1,279.08
17	\$1,330.89
18	\$1,410.93
19	\$1,469.30
20	\$1,478.56
21	\$1,540.64
22	\$1,618.06
23	\$1,679.28
24	\$1,752.32
25	\$1,871.80
26	\$1,901.67
27	\$1,944.11
28	\$1,986.55
29	\$2,028.99
30	\$2,083.03
31	\$2,139.16
32	\$2,195.29
33	\$2,264.50
34	\$2,324.01
35	\$2,642.22

Using the information on the previous page, one can determine the impact in overall cost (ticket plus increase in premium) for a number of traffic violations.

For example, consider a new driver who receives a second \$50 ticket for a minor moving violation. New drivers are automatically placed at an SDIP level of 15. Upon receiving a second \$50 ticket for a minor moving violation, the SDIP level would be 17. Therefore, the annual cost of the policy would go from \$1,127.52/year for SDIP level 15 to \$1,330.89/year for SDIP level 17, a difference of \$203.37. If the driver receives no additional tickets during that year, the driver would move to SDIP level 16, and would pay \$1,279.08 for that year instead of \$1,076.41 for an SDIP level 14, the level that the driver would have been if he/she had not received a ticket. The difference in the second year is \$202.67. Therefore, over the two-year period following the ticket, the driver has had to pay an additional two point penalty of \$406.04 (\$203.37+\$202.67) plus \$50 for the ticket for a total cost of \$456.04.

Questions:

Consider the following scenarios in which a driver's SDIP step increases as a result of a driving incident.

1. What would be the total cost over two years for a driver at SDIP level 28 for a second \$50 minor moving violation ticket?
2. If a driver has a minor accident, the SDIP level increases by three levels. What would be the total policy increase in cost over three years for a driver at SDIP level 20 who was involved in a minor accident? (Assume no additional tickets or accidents over the next three years.)

Some useful things to keep in mind:

- After a single incident, a driver's SDIP step and insurance premium will be higher for a number of years. To compute the *total* premium increase, you need to consider *every* year for which the premium is greater than if there had been no incident at all.
- If a driver's SDIP step is still greater than 14 after three years of incident-free driving, the SDIP is automatically reduced to 14
- The maximum SDIP step is 35.

Question 5: How does the new point system work?

The state of Maine revised its Safe Driver Insurance Plan (SDIP). The process of assigning drivers to “steps” based on their driving history was replaced with a system based on “surcharge points.” If a Maine driver commits a moving violation or is at fault in an accident, then surcharge points are added to the driver’s record. The more surcharge points a driver has accumulated, the higher his or her car insurance premium will be.

The following rules outline the new SDIP system:

- Each type of incident has a number of surcharge points assigned to it. The point values are given in the table below. A driver is assigned a surcharge point total, which is simply the sum of the surcharge points for each driving incident.

Surchargeable Incident	Surcharge Points
Major Traffic Violation (i.e., D.U.I.)	5
Major At-Fault Accident (claim over \$2,000)	4
Minor At-Fault Accident (claim over \$500 to \$2,000)	3
Minor Traffic Violation (i.e., speeding)	2

- The lowest possible total number of surcharge points is zero, and the total may not exceed 45.
- When examining a driver’s history, the insurance company only considers incidents that occurred in the past six years. **Driving incidents older than six years old are removed from one’s driving record.** The six-year period preceding the date your insurance policy will take effect is called the *policy experience period*.
- **No surcharge points are assigned for any incidents in the sixth and oldest year of the policy experience period.**
- If a driver has been incident-free for the past three years *and* has no more than three surchargeable incidents in the past five years, then the surcharge point value for each incident still on the driver’s record is decreased by 1.
- If a driver has at least five years of driving experience and has had no surchargeable incidents in the past five years, then the driver receives the Excellent Driver Discount. Drivers also receive this discount if their only surchargeable incident is *one* minor traffic violation that is at least three years old.
- If a driver has had no surchargeable incidents for the past six years (and has a least six years of driving experience), then the driver receives the Excellent Driver Discount Plus.
- A driver’s surcharge points – and discounts, if applicable – affect their insurance premium. Changes in premium are based on a “base rate” and are determined as follows:
 - For inexperienced drivers (less than six years of driving experience), each surcharge point causes an increase in premium equal to 7.5% of the base rate.
 - For experienced drivers (at least six years experience), each surcharge point causes an increase in premium equal to 15% of the base rate.
 - The Excellent Driver Discount results in a decrease in premium equal to 7% of the base rate.
 - The Excellent Driver Discount Plus causes a decrease in premium equal to 17% of the base rate.

Instructions:

Your task is to determine the premium for four Maine drivers, each with a unique driving history using the information on the previous page.

Start by computing the surcharge points for each driver and use those surcharge points to determine the increase in premium from the base rate. Show all work for each driver.

Remember- any claims 6 years or older do not apply according to the new rules

Driver A

Policy year: 2006

Years of driving experience: 17

Base rate: \$900.00

Driving history:

2004: Minor At-Fault Accident

2003: Minor Traffic Violation

2000: Minor Traffic Violation

Driver C

Policy year: 2007

Years of driving experience: 11

Base rate: \$1,300.00

Driving history:

2005: Minor Traffic Violation

2004: Minor Traffic Violation, Minor At-Fault Accident

2003: Minor Traffic Violation

2002: Major Traffic Violation

Driver B

Policy year: 2008

Years of driving experience: 5

Base rate: \$1,150.00

Driving history:

2003: Minor Traffic Violation

Driver D

Policy year: 2009

Years of driving experience: 35

Base rate: \$850.00

Driving history:

No surchargeable incidents in policy experience period.